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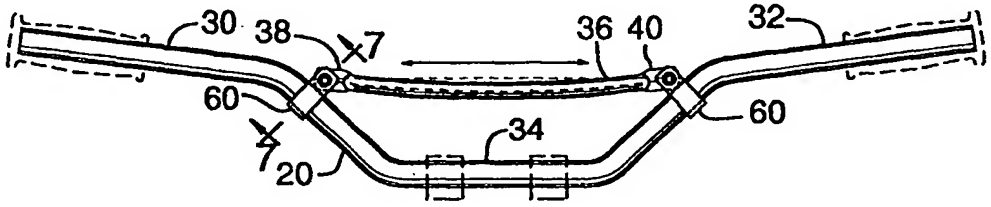

(57) Abstract

The system (18) includes a handlebar (20) having a pair of opposed end portions (30, 32) and a central incurved portion (34) extending between the end portions (30, 32). A tubular insert (90) extends within the handlebar (20) between the opposing end portions (30, 32), and a curved crossbar (36) spans the incurved portion (34). The curved crossbar (36) flexes to minimize the stress between the crossbar (36) and the handlebar (20) during repeated impacts. This flexing improves the endurance of the handlebar system (18) when it is subjected to repeated stresses. Moreover, the insert (90) reinforces the handlebar (20), which further increases the handlebar system's resistance to failure due to repeated stresses. The handlebar system (18) may also include multi layer handgrips (50) that include an inner layer (52), an intermediate layer (54) and an outer layer (56). The intermediate layer (54) is more rigid than the inner (52) and outer (56) layers so that the outer layer (56) is isolated from the inner layer (52) and subjected to less vibrations. The end portions (30, 32) of the handlebar (20) may have a reduced diameter to facilitate the use of such multi layer handgrips without increasing the outer diameter of the handgrips.

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HANDLEBAR SYSTEM

FIELD OF THE INVENTION

The present invention relates to handlebars for vehicles, such as mountain bicycles and off-road motorized racing bikes.

BACKGROUND OF THE INVENTION

Handlebars for vehicles, such as motorcycles, all terrain vehicles, mountain bikes, snowmobiles, and jet skis are well known. A typical handlebar for such applications includes opposing end portions or handle portions and a centrally located incurved portion that extends downwardly from the handle portions and is connected to the vehicle. Frequently during use, the end portions of the handlebar are subjected to downwardly directed forces from a rider, which create bending moments and corresponding stresses in the handlebar. Many handlebars are not able to withstand such repeated stresses, and eventually the incurved portion plastically spreads outwardly.

Thus, handlebar systems often include a crossbar that spans the incurved portion of the handlebar to prevent the incurved portion from spreading. The crossbar is a straight bar that serves as a rigid column interconnecting opposing sides of the incurved portion. However, such a crossbar creates stress concentrations in the handlebar at the points where the crossbar attaches to the handlebar, and the repeated stresses in the handlebar eventually lead to fatigue failure at the points where the crossbar attaches.

Moreover, this crossbar solution to the handlebar stress problem constrains movement in the handlebar that would otherwise dampen vibrations and isolate shocks from the vehicle. Thus, such vibrations and shocks are transmitted to the hands of the rider, making the vehicle more difficult to control and causing the rider discomfort.

One proposed solution to this problem is to make the handlebar from titanium, and internally reinforce the handlebar with a short insert in the areas where the crossbar attaches to the handlebar. Titanium is more resistant to fatigue

failure than steel or aluminum. However, titanium is expensive, resulting in relatively high manufacturing costs. Additionally, one still would expect this handlebar design to subject the rider to significant vibration.

U.S. Patent No. 5,117,708 by Boyer et al. discloses a handlebar design that attempts to solve the problems associated with crossbars by eliminating the crossbar altogether. To compensate for the lost strength and stiffness due to eliminating the crossbar, the Boyer handlebar system includes a handlebar that has an increased diameter in the incurved portion. However, the large diameter incurved portion is not easily secured to existing vehicles which are designed to mount conventional handlebars having a smaller diameter at the mounting location. Equally important, one would expect the handlebar to undergo greater elastic deformation than a handlebar having a crossbar, causing the rider to have a feeling of less control over the vehicle. One would also expect this design to subject the rider to significant vibration.

BRIEF SUMMARY OF THE INVENTION

Thus, there is a need for a handlebar system that compensates for the problems associated with traditional crossbars and handlebars, is relatively inexpensive to manufacture, and is easily secured to existing vehicles. The present invention provides a handlebar system that is stiff and strong, withstands repeated stresses, dampens vibrations and shocks to the rider, and is easily secured to existing as well as newly manufactured vehicles.

In a preferred embodiment of the invention, the handlebar system includes a handlebar having a pair of opposed end portions and a central incurved portion extending between the end portions. A tubular insert extends within the handlebar between the opposing end portions, and a curved crossbar spans the incurved portion. The curved crossbar flexes to minimize the stress between the crossbar and the handlebar during repeated impacts. This flexing improves the endurance of the handlebar system when it is subjected to repeated stresses. Moreover, the insert reinforces the handlebar, which further increases the handlebar system's resistance to failure due to repeated stresses.

The handlebar system of the present invention may also include multi-layer handgrips having an inner layer, an intermediate layer and an outer layer. The intermediate layer is more rigid than the inner and outer layers so that the outer layer is isolated from the vibrations of the inner layer, and the hands of the rider are subjected to less vibrations. The end portions of the handlebar may have a reduced diameter to facilitate the use of such multi layer handgrips without significantly increasing the outer diameter of the handgrips.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view of a motorcycle including a handlebar system according to the present invention.

FIG. 2 is a perspective view of a handlebar system according to the present invention.

FIG. 3 is a broken away sectional view of a handlebar end according to the present invention.

FIG. 4 is a top plan view of the handlebar system of FIG. 2.

FIG. 5 is a front plan view of the handlebar system of FIG. 2.

FIG. 6 is a front plan view of an alternative embodiment of the present invention.

FIG. 7 is a sectional view taken along line 7-7 in FIG. 5.

FIG. 8 is a partial sectional view of a handlebar and an insert according to the present invention.

FIG. 9 is an enlarged sectional view of an alternative handgrip embodiment of the present invention.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring to FIG. 1, a typical motorcycle 10 includes a front wheel 12 and a rear wheel 14 that contact a vehicle support surface. The motorcycle also includes a seat 16 for supporting a rider thereon, and a handlebar system 18 for supporting the hands of the rider and for steering the motorcycle 10. The handlebar system 18 includes a handlebar 20 attached to the motorcycle 10 forwardly of the rider.

Although the present invention is described in the context of a motorcycle, it will be appreciated that the handlebar system of the present invention can be used advantageously in other vehicle applications, especially applications where the rider applies a substantially vertical force on the handlebar or the handlebar otherwise is subjected to shock loading or cyclical fatigue stresses. Other applications include, for example, all-terrain vehicles, mountain bikes, snowmobiles, and jet skis.

Referring now to FIGS. 2, 5, and 6, the handlebar 20 preferably includes a right handle portion 30, a left handle portion 32 and an incurved portion or central portion 34 intermediate the left and right handle portions. The incurved portion 34 extends downwardly from the handle portions and is secured to the motorcycle 10 (FIG. 1). The overall configuration of the handlebar is conventional. Using a horizontal vehicle support surface as a frame of reference, the centermost section of the incurved portion 34 is substantially parallel to the vehicle support surface. At outboard ends of the centermost section, the handlebar bends upwardly, preferably at about a 45° angle relative to the vehicle support surface, to complete the incurved portion 34. Moving further outboard, the handlebar bends again, this time at a shallower angle relative to the vehicle support surface, to form the handle portions 30, 32. The handle portions may be parallel to the vehicle support surface but, preferably, are oriented at a shallow upwardly inclined angle relative to the vehicle support surface, as shown in FIGS. 5, 6, and 8. The handle portions preferably also are bent (relative to the incurved portion) slightly backwardly toward the rider, as shown in FIG. 4. It will be appreciated, however, that the exact configuration of the handlebar is not critical and can be modified to suit particular applications and design considerations.

Referring to FIGS. 1 and 2, a crossbar 36 spans the incurved portion 34, and is secured to the handlebar 20 at opposing flattened ends 38, 40. Preferably, the entire incurved portion 34 lies substantially within a plane tilted about 0 to 45° from a vertical axis (i.e., an axis substantially normal to the vehicle support surface). This tilt angle typically will be about 30° for off-road racing motorcycles, making the plane substantially parallel to the forks of the motorcycle (which typically also are inclined backwardly about 30° from the vertical axis),

thereby allowing the rider to most efficiently counter shock loads and other forces transmitted to the handlebar by the motorcycle frame and front wheel. However, the incurved portion tilt angle can vary depending on the particular application, design considerations, and rider preference. For example, referring to FIG. 1, the incurved portion plane may be inclined rearwardly at an angle A of 30° from vertical as just described, inclined rearwardly as much as about 45° (angle B in FIG. 1), or oriented in a substantially vertical position.

Referring now to FIG. 3, the right handle portion 30 preferably terminates at a handle end 30a having a reduced outer diameter adapted to fit snugly within a handgrip 50. Though not shown, the left handle portion 32 is similarly constructed. The incurved portion 34 and inboard segments of the left and right handle portions preferably have a substantially constant outer diameter which is greater than the reduced, substantially constant outer diameter of the left and right handle ends 30a. The reduced diameter allows the left and right handle ends to receive handgrips 50 having a relatively small inner diameter and relatively large thickness, while still retaining an outer diameter that is easily and comfortably gripped by the rider. In a preferred embodiment, the outer diameter of each handle end is about 0.70 inch and the diameter of the remainder of the handlebar (including the incurved portion) is about 0.88 inch.

The handgrips 50 preferably include an inner layer 52 of resilient material, an intermediate layer 54 of relatively rigid material, and an outer layer 56 of resilient material. The intermediate layer 54 isolates the outer layer 56 from the inner layer 52 so that vibrations will be dampened before reaching the outer layer, and thus before reaching the hands of the rider. The reduced outer diameter of the handle ends allows the thickness of the handgrips 50 to be increased without increasing the outer diameter of the handgrips, thereby improving the damping qualities of the handgrips so that the rider's hands will be further isolated from the vibrations and shock loads.

Referring now to FIG. 5, the crossbar 36 preferably is curved so that it will flex, or straighten when the handle portions 30, 32 of the handlebar 20 are subjected to substantially vertical forces that tend to spread the incurved portion 34 of the handlebar. The crossbar 36 is arcuate or bow shaped. In one

embodiment, the crossbar has a constant radius of curvature of about 44.3 inches and is about 12.25 inches long. The constant radius of curvature allows the crossbar 36 to flex substantially equally along its entire length, rather than having the flex occur primarily within a single area of stress concentration. Although the crossbar preferably defines a circular arc, it may have a variety of curved shapes and radii of curvature as long as the crossbar will flex when the end portions 30, 32 of the handlebar 20 are subjected to substantially vertical forces.

As shown in FIGS. 4 and 5, the crossbar 36 preferably lies substantially within the same plane as the incurved portion 34 and curves downwardly toward the vehicle support surface. Alternatively, the crossbar may curve upwardly as shown in FIG. 6, or it may curve out of the plane of the incurved portion 34. It will be appreciated that the terms "vertical," "upward" and "downward" are relative terms which are most accurate when the vehicle support surface is perfectly horizontal. If the vehicle support surface is sloped, it makes more sense to construe "vertical" to mean a direction normal to the vehicle support surface, and construe "upward" and "downward" to mean away from or toward the vehicle support surface, particularly in those contexts where the slope is substantial.

Referring to FIG. 7, the ends 38, 40 of the crossbar 36 preferably are flattened. Each end 38, 40 preferably defines a centrally located aperture 42 that extends substantially normal to the plane defined by the arcuate crossbar. The ends 38, 40 of the crossbar 36 preferably are secured to the handlebar 20 by clevis clamps 60. Each clevis clamp 60 preferably includes an eye 62 disposed around the handlebar 20, and first and second hubs 64, 66 extending tangentially from opposing sides of the eye. The first hub 64 defines a first aperture 68 for receiving a threaded pin 70. In a preferred embodiment, the aperture 68 is enlarged to receive the head of the pin 70 in a recessed manner. The second hub 66 defines a second aperture 72 for receiving the pin 70. In a preferred embodiment, wherein the pin 70 is a bolt, the second aperture 72 is threaded to engage the threads of the bolt. The pin 70 extends through the first aperture 68, through the aperture 42 in the end of the crossbar 36, and into the second aperture 72.

As the pin 70 is turned into the threads in the second aperture 72, the eye 62 of the clevis clamp 60 contracts around the handlebar 20 before the hubs 64, 66 clamp onto the ends 38, 40 of the crossbar 36, such that the ends of the crossbar are not clamped by the clevis clamps 60. Thus, the crossbar 36 is pivotally connected to the handlebar 20, with the pins 70 serving as pivots. The crossbar 36 may be pivotally connected in some other manner, as long as the pivotal connections allow the crossbar to flex, preferably in a substantially unrestrained manner.

A first O-ring 74 is positioned between the end 38 of the crossbar 36 and the first hub 64, and a second O-ring 76 is positioned between the end 38 of the crossbar 36 and the second hub 66. The O-rings 74, 76 keep the crossbar 36 from rattling when the handlebar 20 is subjected to vibrations or shocks, while allowing the crossbar to pivot in a substantially unrestrained manner on each pin 70.

An adhesive tape 80 (FIG. 7) preferably is positioned between the handlebar 20 and the eye 62 of each clevis clamp (FIG. 7). The adhesive tape 80 helps prevent the clamp 60 from sliding along the handlebar 20 during use, and dampens vibrations between the clamp and the handlebar. The tape preferably has adhesive material on both sides, and preferably has good damping qualities. In a preferred embodiment, the adhesive tape is 15 mil double sticky foam tape, such as double sticky No. 4926 available from 3M®.

In a preferred embodiment, the handlebar system 18 includes an elongate tubular inner tube 90 (FIG. 8) supported within the handlebar 20 (which likewise is tubular). The inner tube 90 preferably extends along the entire length of the handlebar 20 so that the entire length of the handlebar is internally supported. However, the inner tube 90 may extend substantially the entire length of the handlebar 20; for example, the inner tube may stop just short (one or two inches, for example) of the ends of the handlebar. The outer diameter of the elongate inner tube should be slightly less than the inner diameter of the handlebar to permit the inner tube to supportively contact the handlebar. A loose or sloppy fit between the inner tube and handlebar is not desirable because it creates less support for the handlebar and allows the inner tube to vibrate or otherwise move within the handlebar. The inner tube provides the handlebar system 18 with a

balance between stiffness and strength.

The handlebar 20, crossbar 36, clamps 60, and inner tube 90 are preferably made of a material that is rigid, strong, light, and easily manufactured. In a preferred embodiment, the handlebar 20, crossbar 36, clamps 60, and inner tube 90 are all made of an aluminum alloy such as 7050 aluminum. However, the handlebar 20, crossbar 36, clamps 60, and inner tube 90 can be made of some other material, such as titanium. Moreover, it should be understood that the handlebar 20, crossbar 36, clamps 60, and inner tube 90 each may be made of different materials, even when used within the same handlebar system 18.

The inner layer 52 and outer layer 56 of the handgrips 50 are preferably made of a resilient material, such as urethane. The intermediate layer 54 preferably is made of a rigid material such as sheet metal, hard rubber or plastic.

The O-rings 74, 76 are preferably made of a resilient compressible material to prevent the crossbar 36 from rattling during use, even when the hubs 64, 66 are not clamped tightly on the crossbar 36. In a preferred embodiment, the O-rings are made of conventional o-ring material such as rubber.

In making the handlebar system of the present invention, the inner tube is inserted inside the outer tube. The ends of the tubes are then swedged down to form the reduced-diameter handle ends. During the swedging, the outer tube is swedged, which in turn swedges the inner tube. The tubes are then bent to form the shape of the handlebar as shown in FIGS. 1-5, with the inner tube 90 forming an elongate insert and the outer tube forming the handlebar 20. The resulting assembly, including the handlebar 20 and inner tube 90, is then heat treated. By way of example, if the insert 90 and the handlebar 20 are made of 7050 aluminum, the heat treatment steps include heating the assembly to about 9001F, quenching the assembly, and age hardening the assembly at 3501F for about 12 hours. The outer surface of the handlebar is then shot peened in a conventional manner, using any standard shot peening process for hard alloy aluminum.

The tape 80 is then applied around the handlebar 20 in the areas where the clamps 60 will clamp onto the handlebar, just inboard of the outermost bends. The clamps 60 are then slid over the tape 80 on each side of the incurved portion 34, and the crossbar 36 is positioned so that each crossbar aperture aligns with the

first and second apertures 68, 72 of the clamp 60. The O-rings 74, 76 are then positioned on opposing sides of each crossbar end 38, 40, and each pin 70 is inserted through the aligned apertures and threaded into its respective clevis clamp. The pins 70 are tightened so that the clamps 60 clamp securely onto the handlebar 20 without clamping the crossbar ends.

The handgrips 50 preferably are made by inserting the rigid layer 54 within an injection mold, subsequently injecting molten material into the mold, and allowing the molten material to solidify. The molten material becomes the inner layer 52 and the outer layer 56. The handgrips 50, which have a reduced inner diameter compared to standard handgrips, are then forced over the handle ends. The resulting handgrip provides a relatively thick yet well-supported handgrip to better dampen vibrations. Though thicker than conventional handgrips, the outer diameter remains the same as conventional handgrips.

In an alternative handgrip embodiment shown in FIG. 9, a metal sleeve 92 made, for example, of an aluminum alloy is positioned coaxially over swedged handlebar end 30a. Before or after such positioning, the outer surface of the handlebar end and inner surface of the sleeve preferably are primed with a chromate coating. By injection molding, the space between the handlebar end and sleeve is filled with urethane, rubber or like material to provide a damping material layer 96 therebetween. The damping material, when it solidifies, bonds to the handlebar end and sleeve. Alternatively, a two-step process can be used, first by forming the bonded urethane layer 96 over the handlebar end 30a and then bonding the first sleeve coaxially over the layer 96. With either approach, the resulting construction produces handgrip ends having the same outer diameter as the remainder of the handlebar, enabling the rider to use standard handgrips. Yet, the construction provides an additional layer of damping material to reduce vibration transmitted from the vehicle frame to the rider through the handlebar.

The resulting handlebar system 18 is then secured to the vehicle. This typically may be done using existing mounts from the vehicle. The present invention offers several advantages. The use of a two-tube structure gives the handlebar added strength. Vibration is reduced because each tube has different natural frequencies. The inner tube helps dampen vibration, particularly at the

outer tube's natural or resonant frequencies. Moreover, the invention reduces if not eliminates the risk of catastrophic fatigue failure in which a portion of the handlebar completely breaks away, typically at a crossbar mounting location, leaving the rider with little or no steering control. Should the outer tube of the present invention so fail, the inner tube maintains some level of structural integrity so that the rider retains steering control. Stated another way, the handlebar system of the present invention lasts longer and when it does fail, it fails in a perceptible manner which allows the rider to safely maintain steering control under even dangerous conditions.

Furthermore, the curved crossbar of the present invention reduces handlebar stress at the crossbar mounting locations, contributing to the handlebar's longer life before failure. Yet, the curved crossbar provides a limit point at which elastic deformation of the handlebar is cut off, thereby damping vibration to a significant extent without giving the handlebar an undesirable "soft" feel which riders associate with lack of control and responsiveness.

In addition, the handgrip feature of the present invention operates to further dampen vibration experienced by the rider. It will be appreciated that while the performance of the present invention can be optimized by using the features described herein in combination, such features can be individually incorporated into handlebar designs with advantageous results.

Although the invention has been described with reference to specific embodiments, it should be apparent to those of ordinary skill in the art that the arrangement and details disclosed herein may be modified without departing from the spirit and scope of the invention. Therefore, we claim all such modifications as fall within the scope and spirit of the following claims and all equivalents thereto.

CLAIMS

I claim:

1. A handlebar system, comprising:

a tubular handlebar having a handlebar length, and

a tubular insert located coaxially inside the handlebar and extending substantially the entire length of the handlebar, the tubular insert supportively engaging the handlebar without a friction fit therebetween.

2. The handlebar system of claim 1, wherein the handlebar includes a centrally located incurved portion.

3. The handlebar system of claim 2, wherein the incurved portion lies substantially within a plane.

4. The handlebar system of claim 3, further including a curved crossbar spanning the incurved portion, the crossbar having opposite ends supported by the incurved portion.

5. The handlebar system of claim 4, wherein the crossbar lies substantially within the plane, the opposite ends being pivotally connected to the incurved portion at respective first and second pivots, the first and second pivots being substantially normal to the plane.

6. The handlebar system of claim 1, wherein the handlebar includes opposed ends having a reduced outer diameter relative to the incurved portion.

7. The handlebar system of claim 6, including a multi layer handgrip mounted coaxially over each end of the handlebar.

8. The handlebar system of claim 1, wherein the handlebar includes an outer surface portion, which is shot peened.

9. A handlebar system for use in steering a vehicle moving over a surface, comprising:

a tubular handlebar including first and second opposed end portions and a centrally located incurved portion, the incurved portion lying substantially within a plane; and

a curved crossbar spanning the incurved portion, the crossbar having opposite ends pivotally supported by the incurved portion, the crossbar being capable of flexing to resist forces acting on the tubular handlebar which have a tendency to spread apart the first and second end portions.

10. The handlebar system of claim 9, wherein the crossbar is arcuate.

11. The handlebar system of claim 9, wherein the curved crossbar lies substantially within the plane.

12. The handlebar system of claim 11, wherein the opposite ends of the crossbar are pivotally connected to the incurved portion at respective first and second pivots, the first and second pivots being substantially normal to the plane.

13. The handlebar system of claim 9, wherein the opposite ends of the crossbar are pivotally connected to the incurved portion at respective first and second pivots.

14. The handlebar system of claim 9, further including first and second clevis clamps, each clamp including an eye clamped around the handlebar, a pair of arms extending from the eye and defining a channel therebetween, and a pin extending between the arms, wherein the opposite ends define first and second apertures, respectively, the opposite ends being positioned within the channels of the first and second clamps, respectively, and the first and second apertures receiving the pins of the first and second clamps, respectively.

15. The handlebar system of claim 14, further including adhesive tape disposed between the eyes of the first and second clamps, and the handlebar.

16. The handlebar system of claim 9, further including a tubular insert located inside the handlebar and extending substantially the entire length of the handlebar.

17. The handlebar system of claim 9, wherein the opposed end portions of the handlebar have a reduced outer diameter relative to the incurved portion.

18. A handlebar system, comprising:

a tubular handlebar including a centrally located incurved portion; and

a curved crossbar spanning the incurved portion, the crossbar lying substantially within a plane, and the crossbar including a first end pivotally connected to the handlebar about a first pivot, and an opposing second end pivotally connected to the handlebar about a second pivot, the first and second pivots being substantially normal to the plane.

19. The handlebar system of claim 18, wherein the crossbar is arcuate.

20. The handlebar system of claim 18, wherein the incurved portion lies substantially within the plane.

21. The handlebar system of claim 18, wherein the handlebar has a length and the handlebar system further includes a tubular insert positioned inside the handlebar and extending substantially the entire length of the handlebar.

22. The handlebar system of claim 18, wherein the handlebar includes opposed ends having a reduced outer diameter relative to the incurved portion.

23. The handlebar system of claim 18, wherein the handlebar includes an outer surface portion, which is shot peened.

24. The handlebar system of claim 18, further including first and second clevis clamps, each clamp including an eye clamped around the handlebar, a pair of arms extending from the eye and defining a channel therebetween, and a pin extending between the arms, wherein the first and second ends of the crossbar define first and second apertures, respectively, the first and second ends being positioned within the channels of the first and second clamps, respectively, and the first and second apertures receiving the pins of the first and second clamps, respectively.

25. The handlebar system of claim 24, further including adhesive tape disposed between the eyes of the first and second clamps, and the handlebar.

26. A handlebar system, comprising:

a handlebar including a centrally located incurved portion, a pair of opposed end portions located on opposite sides of the incurved portion and a substantially constant outer diameter central portion extending between the end portions, the end portions having a reduced outer diameter relative to the central portion and incurved portion, whereby the end portions each are capable of receiving a hand grip having an inner diameter less than the outer diameter of the central portion.

27. The handlebar system of claim 26, further comprising a tubular insert extending within the handlebar at least between the opposing end portions.

28. The handlebar system of claim 27, wherein the central portion includes an incurved portion lying substantially within a plane.

29. The handlebar system of claim 28, further comprising an arcuate crossbar spanning the incurved portion, the crossbar lying substantially within the plane.

30. The handlebar system of claim 29, further including first and second clevis clamps, each clamp including an eye clamped around the handlebar, a pair of arms extending from the eye and defining a channel therebetween, and a pin having a longitudinal axis that is substantially perpendicular to the plane extending between the arms, wherein the crossbar has opposing first and second ends defining first and second apertures, respectively, the first and second ends being positioned within the channels of the first and second clamps, respectively, and the first and second apertures receiving the pins of the first and second clamps, respectively.

31. The handlebar system of claim 30, further including adhesive tape disposed between the eyes of the first and second clamps, and the handlebar.

32. The handlebar system of claim 26, including a multi-layer grip mounted coaxially over each end portion, the grip including at least one layer of resilient material and at least one layer of substantially rigid material in substantially coaxial relationship.

33. The system of claim 32, wherein the grip includes at least a second layer of resilient material, the layer of rigid material being disposed substantially coaxially between the layers of resilient material.

34. The system of claim 26, wherein a layer of resilient material is affixed coaxially over each end portion, and a layer of rigid material is affixed coaxially over each layer of resilient material, the layer of rigid material having an outer diameter substantially equal to the diameter of the central portion.

FIG.1

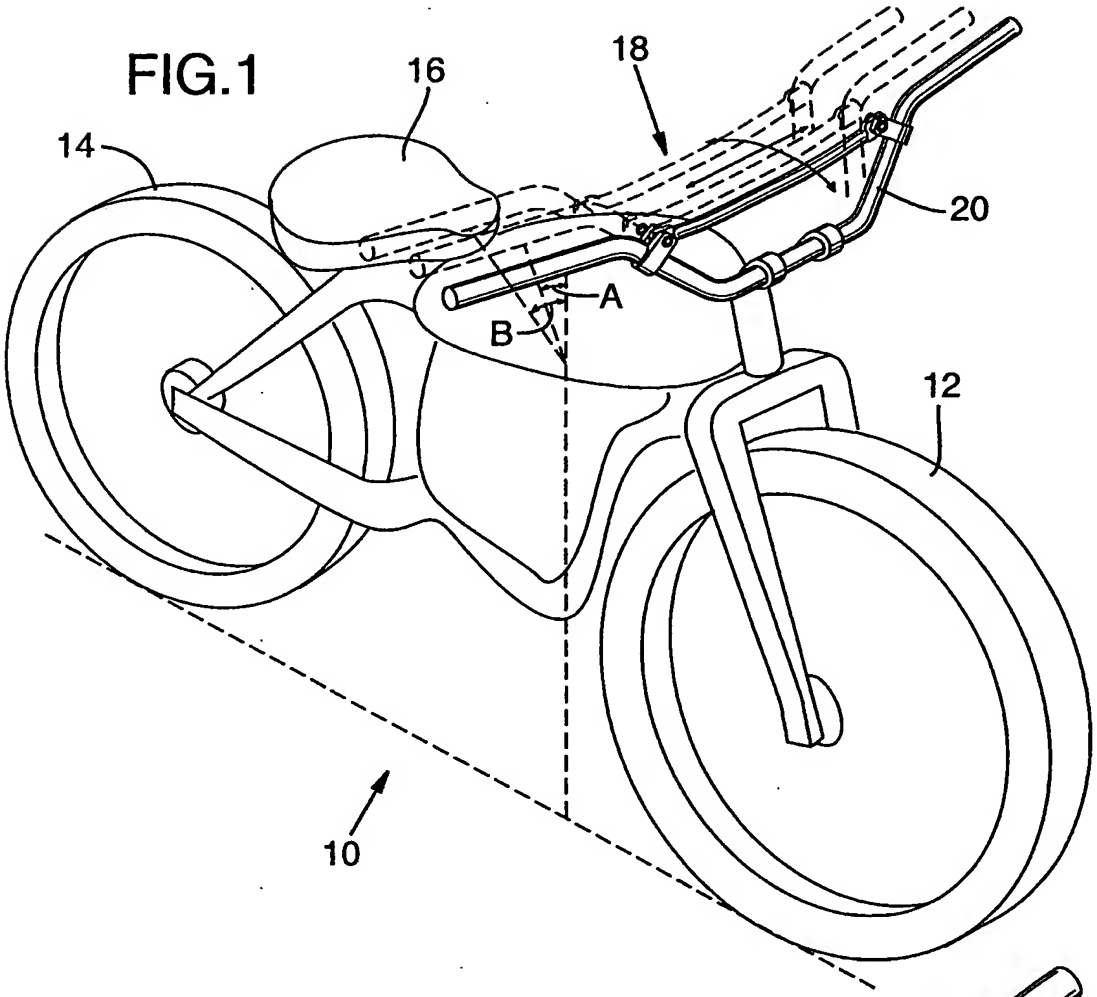


FIG.2

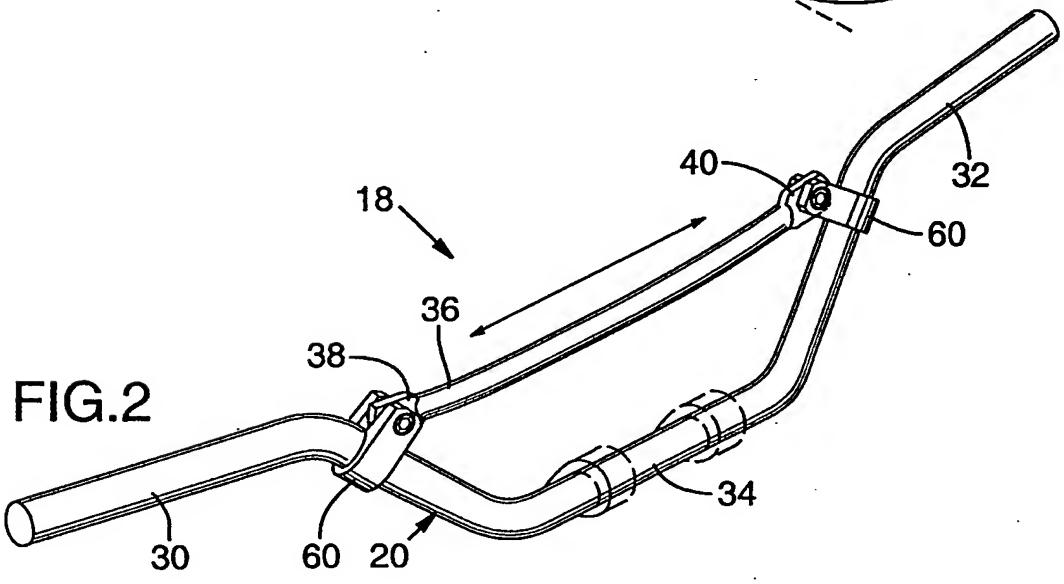
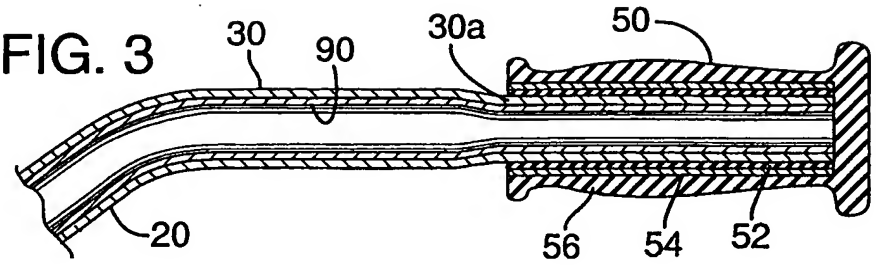


FIG. 3



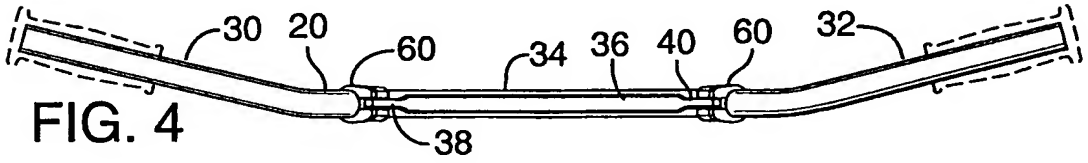


FIG. 4

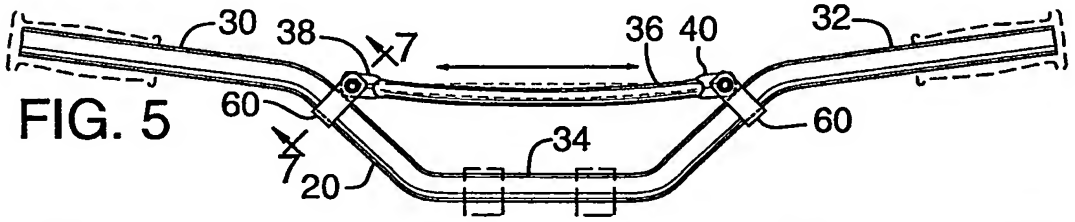


FIG. 5

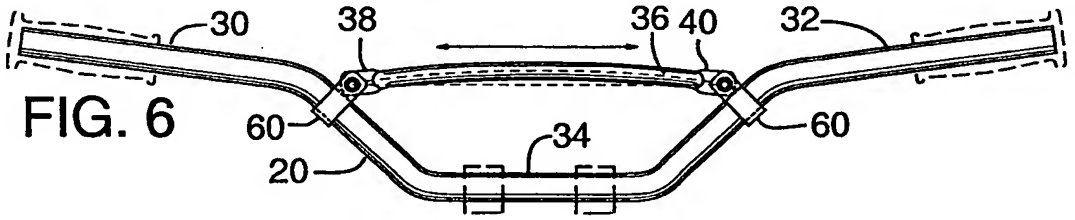


FIG. 6

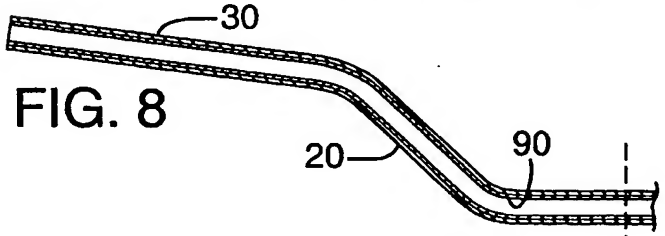


FIG. 8

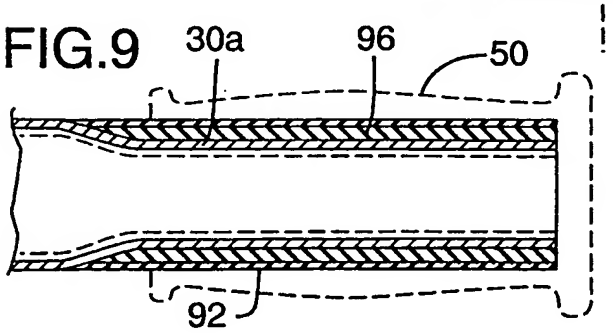
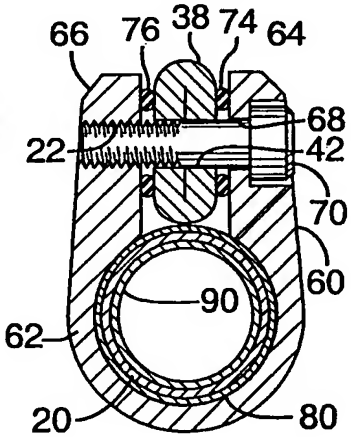


FIG.9

FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/21608

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :B62K 21/12
US CL :74/551.1, 551.8, 551.9
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 74/551.1, 551.8, 551.9; D12/178; 280/288.4

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 5,257,552 A (BOYER ET AL.) 02 NOVEMBER 1993 (02/11/93), SEE ENTIRE DOCUMENT.	26 AND 34 --- 6, 7, 17, 21, AND 27-33
X, P --- Y, P	US 5,832,785 A (COSTAHAUDE ET AL.) 10 NOVEMBER 1998 (10/11/98), SEE ENTIRE DOCUMENT.	1-3 AND 8 --- 1-7, 16, 21, AND 27-31
Y	US 5,064,157 A (O'NEAL) 12 NOVEMBER 1991 (12/11/91), SEE ENTIRE DOCUMENT.	1-5, 9-21, 23-25, 30, AND 31

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 18 NOVEMBER 1999	Date of mailing of the international search report 23 DEC 1999
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer MARY ANN BATTISTA Diane Smith Telephone No. (703) 308-2168

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/21608

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,337,962 A (ALLEN ET AL.) 06 JULY 1982 (06/07/82), SEE ENTIRE DOCUMENT.	1-5, 9-21, 23-25, 29, 30, AND 31
Y	US 4,785,495 A (DELLIS) 22 NOVEMBER 1988 (22/11/88), SEE ENTIRE DOCUMENT.	7, 15, 25, AND 31-33